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Agricultural Research in New Hampshire

Annual Report of the Director of the New Hampshire Agricultural Experiment Station for the Year 1933

UNIVERSITY OF NEW HAMPSHIRE

Durham, New Hampshire

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AGRICULTURAL RESEARCH IN NEW HAMPSHIRE

Annual Report of the Director of the New Hampshire Agricultural Experiment Station for the Year 1933

J. C. KENDALL, Director

The necessity for a foundation of reliable and up-to-date information upon which to build an agricultural program in this state has never been more evident than during the past year. The "new deal" with all the various economic and social changes which it has involved has called for many types of information. The need for many new projects in agricultural research is evident, particularly in the field of Agricultural Economics where it is most fortunate that we have the advantage of several years of investigations made possible by the Purnell Act. In the meantime, the many projects already under way in various departments press for solution.

The following report of the experimental work in the past year is by no means complete, and does not take into account the patient work on many projects on which data are not yet completed, nor the vast amount of state service work, correspondence, consultations, special assistance, lectures, etc., which the staff has been requested to make. These annual reports are designed to present a picture of some of the more important results which have come out of the various projects during the year.

Among the completed projects are the Purnell Studies of Potato Marketing, Hay and Silage Production Costs, Dairy Farm Rotation on Worn-Out Hay Lands, Study of Retail Milk Markets in Laconia, and the Adams project, Study of Burgundy Mixtures and Their Effect on Plants.

New projects being developed involve the Study of the Penetration of Ovicides, Effect of Mulching and Development of Bitter Pit in Apples, Pneumatic Traction Equipment and Heat Requirements for Brooding of Chicks.

This year has seen a valuable development in the renovation of the old dairy barn, and the installation there of offices and laboratories in Agricultural Engineering. This work is being developed under the charge of W. T. Ackerman who is employed by the Experiment Station to develop the study of Rural Electricity.

There have been no changes in personnel during the year except for the appointment of L. J. Bowen as Graduate Assistant in Botany, replacing Mr. Russell Bissey, and of G. M. Foulkrod as Assistant in Agricultural Engineering.

Many Sidelines for Orchardists

Strawberries, cherries, beans, lumbering, dairying, and poultry production are possible sidelines which fit well into orchard organization, according to a study of 12 fruit farms which has just been completed by H. C. Woodworth and G. F. Potter, and will shortly be published. A summary of the investigation lists these facts and conclusions:

The income of the 12 farms fluctuated greatly, ranging from an av-

erage of $80 in 1926 to $2,777 in 1927, a year of good yields and high apple prices.

For greatest efficiency in harvesting, plantings should be divided between a few varieties which ripen successively. One man could not expect to harvest more than 50 mature McIntosh trees, but he could also pick 50 Gravensteins and nearly 100 Baldwins.

Skilled labor for spraying is necessary at definite times.

About 18 per cent of the total man-hours recorded on these farms were devoted to miscellaneous tasks such as care and repair of equipment and discussions with salesmen.

Among the things which may be carried on with apples without serious conflict in the harvesting period are: a small area of beans; winter work on timber, which utilizes men and horses in a slack labor period; where hay and tillage land and good pastures are available, dairying is a good supplementary enterprise; poultry production can be efficiently carried on by rearing early hatched chicks, or purchasing full grown pullets for replacements. (*Purnell Fund*)

Size of Spray Crew May Vary With Spray

The lowest labor cost in spraying was obtained by the use of medium-sized machines operated by one-man crews, according to a spray cost study by E. J. Rasmussen and H. C. Woodworth. Operating with a one-man crew reduces the output of the machine, however. If the sprayer is drawn by a tractor or truck, or if the orchard is rough or the spraying has been delayed, this one-man outfit may not be practical.

It was concluded that the size of the crew should be determined by the topography of the orchard, the power available for hauling the machine, and the time available for applying the spray. When applying the early sprays for scab control, for instance, a crew of two or three men may be necessary to finish the job more quickly and get the spray on in time. During the first cover spray, on the other hand, a one-man crew may be used because this covering can be applied over a longer period without danger of increasing the disease and insect injury.

While an overhead water supply does not appear necessary, growers with supplies located in the orchard are able to apply more gallons of spray per day. One orchardist with a large machine and three water supplies located at different points in his orchard was able to apply 226 gallons of spray per machine-hour. Another grower with a similar machine but only one water supply handled only 177 gallons of spray per machine-hour.

The nozzle should ordinarily match the machine capacity, yet topography of orchard, size of trees and the ability of the man handling the nozzle are also points to consider in determining nozzle size. When the tank can be ridden, a nozzle with a capacity of 12 to 15 gallons per minute is efficient; but on sites where walking and dragging a hose are necessary, a capacity of seven to eight gallons per minute would be the maximum to use on medium to large outfits. The right size pump is one that will cover the orchard in three or four days. (*Purnell Fund*)

Silage Corn for Intensive Farming

Silage corn is the answer for the dairyman who wants more cows, a cash crop, or extra pasture on the same farm. Silage production also helps to spread the labor of roughage harvest over a longer period. Less extra hired help is needed.

Assuming the wage for labor, silage cost $4.52 per ton and hay $5.71. These cost of production figures do not include any charge for land, buildings or manure.

Such are conclusions of the study of roughage production by M. F. Abell on 81 farms in 1928 and on 247 farms in 1929. Publication of these findings appears in Station Bulletin 273, published in July. (*Purnell Fund*)

Local Potato Markets Profitable

Growers who supply their local markets regularly throughout the marketing season will derive the greatest income from potatoes. This is one of the conclusions of the study of potato marketing by E. H. Rinear and M. F. Abell, published in Station Circular 42.

This investigation also revealed that during the 10-year period, 1922-32, more locally grown potatoes were consumed within the state and the supply from outside sources has decreased.

Wholesale prices in New Hampshire averaged 18 cents per hundred over Boston quotations for late crop potatoes between 1926 and 1932 inclusive. (*Purnell Fund*)

Unusually efficient barn work was discovered on one of 38 dairy farms in Grafton county which were the subject of recent efficiency studies by H. C. Woodworth and C. W. Harris, Jr. The results are published in Station Bulletin 275. On this particular place two men were taking care of 6 cows and 40 head of young stock.

The research showed that despite remarkable efficiency in one practice, a farmer might be inefficient in some other respect. The men with low chore hours per cow had more convenient barns, used better methods, and organized their work more skillfully.

Low production of milk on some farms resulted from poor pastures, lack of timely supplementing of dwindling pastures, insufficient protein in the yearly ration, poor quality of cows, and unskilled handling.

Yields and quality of hay could be both improved on most farms by systematically seeding down a larger acreage each year. High protein hay made up only about 15 per cent of the total harvested on these farms.

Further investigations of organization of farms and efficiency in chore work are being made in the Colebrook area. Fifty farmers are cooperating. (*Purnell Fund*)

Small "Profit" on Sale of Cows

Farmers who raise and sell cows as an enterprise separate from milk production got an average of $77 per cow, according to a preliminary study by H. C. Grinnell of dairy-herd replacements in southern New

Hampshire. Not counting value of pasture, average feed cost of raising a heifer on 191 farms was $67 for the year ending May 1, 1933.

The majority of the dairy farmers in southern New Hampshire are raising most or all of their dairy replacements, and in some cases young stock to sell. Cheap milk and abundant pasture are conditions which determine the profitableness of raising young stock as a separate enterprise.

On 201 farms there were 60 heifers for each 100 cows on May 1, 1933. About one-fourth of the cows inventoried at the beginning of the year were disposed of.

About one-half of the cows sold for production by farmers who were raising heifers for herd maintenance were released for reasons which would indicate that they were not profitable cows to own. The average price for these cows was $59 as compared with $77 received by farmers who made it part of their business to raise cows to sell. (*Purnell Fund*)

What Are Extra Costs of Grade A Milk?

To learn the extra costs of producing Grade A milk as compared with Grade B, 100 records were obtained by E. H. Rinear and H. C. Moore from producers shipping through one Grade A station. Additional records must also be gathered from a section producing only Grade B milk before comparative costs can be listed.

Another phase of this study concerns the most economical method of preventing bacterial development in milk from the time it is drawn from the cow until it is delivered to the consumer. (*Purnell Fund*)

Milk Retailing Proves Inviting

Fifty-four producer-distributors in Laconia averaged more on their labor in retailing than their milk was worth at the net wholesale price for the zone. This condition in the lake-city market was brought to light in a study begun by E. H. Rinear in 1932 and published in 1933 in Station Bulletin 272. The cost figures obtained in this investigation are now being used in determining minimum code price for other local markets. (*Purnell Fund*)

Investigating Logging Possibilities

Following the detailed mapping of the town of Dorchester, land-use research in Grafton county was continued this year by H. C. Woodworth and M. F. Abell with a rapid survey of the forest cover of 16 towns. The data on this indicate that the Dorchester forest cover is typical of the large back area of the section. A trained forester with experience in milling and lumber demand is now determining what kind of logging might be done in this area and under what conditions, it might be profitable. If little timber can be taken out profitably in the next 20 years, the people living in these communities will need to seek employment elsewhere. (*Purnell Fund*)

Soy-bean Hay Low in Protein

The small amount of digestible crude protein in soybean hay is one of the surprising finds in the study of forage crops as sources of protein and energy for dairy cows. This crude protein varied from 9.04 per cent in the mixed crop of several small plots to nearly 20 per cent in the harvest from specially treated soil.

Despite this fact soybean hay may be considered a valuable roughage for milk production, for its protein is well utilized and it supplies a liberal amount of energy, ranking in this respect with early cut timothy and second-cutting alfalfa. Even for moderate milk production, however, it should be supplemented with more protein when its own supply is as limited as the poor samples in this study revealed. As a source of protein it proved to be only one-half as valuable as alfalfa and was exceeded by early cut timothy hay.

When cows producing from 25 to 30 pounds of milk were fed alfalfa only its digestible protein was sufficient to supply their demand. It failed to supply enough energy with the result that the animals lost some weight. Had the energy been sufficient, the cows might have produced more milk. Due to its high protein content, however, alfalfa is undoubtedly the most valuable roughage for cows in production.

This study was a part of the nutrition investigations conducted by E. G. Ritzman in cooperation with F. G. Benedict, director of the Nutrition Laboratory of the Carnegie Institute of Washington. (*Purnell Fund*)

Horse Needs More Energy Feed in Winter

For mere existence the horse requires more energy-producing feed in February and less in October as compared with the month of May. This was shown in three metabolism experiments by E. G. Ritzman and F. G. Benedict during the year to determine the seasonal variations in the requirements of the horse.

In terms of heat production per 500 kilograms weight and per square meter of surface area, the results at 84 and 108 hours after feeding were as follows:

For 500 kilograms weight—9,000 calories in October, 9,900 in February, and 9,450 in May.

Per square meter surface area—1,752 calories in October, 1,974 in February, and 1,884 in May. (*Adams Fund*)

Sheep Breeding May Be Simplified

A method tentatively proposed for predicting results of sheep matings may simplify future sheep breeding aimed at a new strain highly productive in wool and mutton, equipped with four functional nipples, and bearing largely twins. Considerable progress has already been made, as reported in Technical Bulletin 53. The work is in charge of E. G. Ritzman. (*Adams Fund*)

Growing Hay on Neglected Land

Following publications of the results of the first six years of work on hay production on neglected hay lands, the fields were replowed and seeded to red clover after unsuccessful seedings to timothy. Following the 1934 red-clover harvest, timothy will be replanted. Nitrogen proved to have the greatest influence on the yield of timothy from 1926 to 1931, as pointed out in Station Bulletin 271. Phosphorus influenced the yield markedly the first year. Lime was also beneficial. These studies are in charge of F. S. Prince and T. G. Phillips. (*Purnell Fund*)

Manure, Potash Help Alfalfa on Worn-Out Soil

Manure and potash were necessary soil treatments in the production of alfalfa on worn-out hay lands, the former giving constant and significant increases in yields and the latter appearing to prolong the life and add to the yield of the legume, according to five years' work in Greenland plots. The results are in Station Bulletin 271. The experimental work is being continued. (*Purnell Fund*)

Greenhouse Soil Testing

Greenhouse experimental work is done each year, testing for deficiencies in the various soil types of the state. Such indicator plants as tomatoes or tobacco are grown. Twenty-four tubs of untreated "original" soil from the Lane farm, Chichester, were tested in 1933, for example. Seven different combinations of fertilizer were used, the soil showing a strong need for phosphorus. (*Hatch Fund*)

New Variety Tests

Seven special variety tests were begun by F. S. Prince and P. T. Blood this year with soy-beans, clovers, lespedezas, commercially important varieties of oats and barley, and mixtures of oats and legumes.

Soy-bean trials included 64 new strains from the federal bureau of plant industry; the nine standard varieties of Dunfield, Mukden, Black Eyebrow, Harbinsoy, Manchu, Pekwa, Illini, Midwest and Wilson; and Pekwa alone and with Hungarian. The Pekwa-Hungarian seeding yielded 1,280 pounds per acre more than the soy-beans alone. This difference in weight was obtained after both crops had been dried in an electric drier.

Of the 64 new strains of soy-beans, about 30 are thought to be suitable for green vegetable purposes and are being tested by the home economics department.

Ladino and White Dutch clovers are also on trial.

Lespedezas included in the tests are two strains of Korean and sericea, a perennial.

Wisconsin and Alpha barleys and Cornellian and Swedish oats were also seeded this year. Legume mixtures include Chang peas and Swedish oats, hairy vetch and Swedish oats and common vetch and Swedish oats. The hairy vetch, spring sown, made as much growth as peas, and both made considerably more growth than spring or common vetch. Since the hairy vetch also makes a good growth in the

fall after the first harvest and often lives over into the second season, it seems much superior to field peas and preferable to common vetch for forage. (*Hatch Fund*)

Top-Dressing for Grass Hay

Top-dressing of grass hay lands was begun on the college farm in 1933 to test the efficiency of the more important nitrogen carriers, to compare these with equal quantities of nitrogen in mixed fertilizers, and to try different dates and different amounts of the same nitrogen carrier. Each of the 14 plots is about one-five hundredth of an acre in extent. (*Hatch Fund*)

Spray or Dust Potatoes

Either spraying or dusting is satisfactory for potatoes in a season like 1933 if the job is properly done, according to a comparative experiment on the Lane farm, Chichester. (*Hatch Fund*)

More Evidence on Early Haying

Time-of-cutting studies on yield and feed value of hay have been continued, following the publication early in 1933 of the conclusions of trials in 1930, 1931, and 1932. The facts point out that grass hay such as timothy, if it is to be of most value for dairy cows, should be harvested before the period of bloom. This means starting haying as early as June 15 in southern New Hampshire and not later than June 25 in the northern section. (*Hatch Fund*)

No Difference From Broadcasting, Drilling Fertilizer

To compare broadcasting versus drilling fertilizer for potatoes and to determine the development of scab at different pH levels, one acre of the crop was grown on the Ireland farm in Greenland in 1933 on a piece of land which had been in sweet clover the previous year and which had been limed and treated with basic slag as a lime carrier, both at different rates. The methods of applying the fertilizer showed no significant differences in yield. The use of basic slag resulted in much less scab than did the lime, and the former was less effective in correcting acidity. (*Purnell Fund*)

Nitrogen Shines in Pasture Research

The dry year of 1932 resulted in universal response to nitrogen in the investigations on top-dressing old pastures. This research is continuous on the Seavey Brothers' farm, Stratham, and in seven other widely scattered regions of the state. What 1933 will show depends on the chemical analysis yet to be made of the harvested grass.

Because of the possibility of different results for the Connecticut valley, an experiment was started near Claremont this year by F. S. Prince, T. G. Phillips, P. T. Blood and G. P. Percival. Fifteen plots were staked out and treated with different nitrogen carriers and varia-

tions of complete fertilizer, with one treatment in which phosphorus and potash alone were applied.

On the Seavey farm, contrary to the previous year's results, superphosphate and potash gave no response in 1932. (*Purnell Fund*)

Phosphorus, Potash Help In Connecticut Valley

To develop the first year's crop phosphorus seems essential to success with red clover and alsike in the Connecticut valley, according to one year's results on the Livingston farm near Claremont. Trials conducted on the 80 twentieth-acre plots also indicated that potash will give significant increases in red clover, but that lime will not since this soil is not excessively acid.

This research on legume production in the Connecticut valley had previously revealed that the best growth of sweet clover and alfalfa came from plots treated with potash. (*Purnell Fund*)

Fertilizer Trials for Southern New Hampshire

Fertilizer trials similar to those long established in Colebrook were begun in Chichester this year for the purpose of getting facts on conditions typical of southern New Hampshire. Nine different commercial combinations are on test in a three-year dairy farm rotation of potatoes, oats and clover on worn-out hay land. Approximately 150 thirtieth-acre plots are laid out in three groups, each of about 50 plots. (*Purnell Fund*)

New Results from the Colebrook Work

The Colebrook experiment occupies 160 twentieth-acre plots divided into three almost equal groups. The same rotation is used as in Chichester, with the 13 variations in fertilizers applied only to the potatoes.

The Norcross variety of potatoes was planted in 1933 instead of Green Mountains, and proved considerably more sensitive to fertilizer variations and particularly to phosphorus. For the first time in the history of this investigation, decrease in yields due to omission of phosphorus was greater than where potash was omitted. The increase in yields where extra phosphorus was added was greater than in any other year save one.

This suggests a study of varieties with reference to their sensitiveness to a lack or abundance of some one fertilizer ingredient.

The Norcross potatoes responded about like Green Mountains in previous years when potash was omitted, and failed to respond to additional potash over the seven per cent. Lime in addition to a fertilizer without potash depressed the yield slightly as in previous years with Green Mountains.

Two tons of lime have caused slightly scabby potatoes on this field; four tons have produced scab on nearly all the potatoes.

Lime increases the yield of clover and other hay species on this land more than any other fertilizer treatment having a continuous effect. All the fertilizer is applied to the potatoes in this experiment; hay-crop harvest is two full years following any fertilizer application.

Enough lime to help the clover without causing scab on the potatoes is the need of this land. What this amount may be is one of the things yet to be determined. (*Purnell Fund*)

Soy-beans Like Magnesium Limestone, Manure

Magnesium limestone and manure stimulated soy-bean yields on the Ireland farm where the soil shows a pH of 4.8. Thirty-two plots have been grown during a three-year period.

Two tons of calcium limestone gave a significant increase over one ton. Magnesium limestone gave noticeably better results than calcium limestone on this particular soil. The continuous effect of 10 tons of manure is apparently more beneficial than 300 pounds of either 10-20-20, or 0-20-20 or 0-20-0 commercial fertilizer. Superphosphate with the manure did not improve the yield. (*Purnell Fund*)

Phosphorus May Be Direct Benefit to Apples

Odds are 20 to one in favor of phosphorus as a fertilizer for apple trees from the standpoint of yield alone, but at a cost of $60 per acre it apparently continues to be impractical from a profit point of view.

Baldwins given a heavy treatment of superphosphate in 1928 yielded an average of 412 pounds per tree in 1933 as compared with 336 pounds in control plots. The average for the last four crops is 298 pounds, which is 44 pounds more per tree than the control plots produced.

That phosphorus may directly increase yields has never before been demonstrated even as conclusively as this. What has been shown in the past is that it has a secondary influence, acting through the cover crop.

In this six-year study by G. F. Potter of the causes and control of fruit-bud formation in the apple, phosphorus has not shown any conclusive results in setting blossom buds or fruit, although more spurs did form blossom buds in response to this treatment. Extra apples and larger size of the fruit were the principal returns from the use of phosphorus.

In applying the superphosphate in 1928, enough was worked into the top eight inches of the soil to increase its phosphorus content by approximately 50 per cent. Control plots got no phosphorus. Trees in both series of plots received an annual application of nitrate of soda on the surface of the sod. Both series were also seeded down.

A companion study during this six-year period concerned the effect of dividing the nitrogen application. The conclusion is that blossom-bud formation is not influenced by applying half the total amount of nitrogen in early spring and the other half in mid-summer. (*Adams Fund*)

Results Reversed on Flower-Bud Study

Analytical work was completed on 110 samples of fruit spurs to determine the relationship of their composition to fruit-bud formation. G. F. Potter and T. G. Phillips report that the results so far noted

do not agree with those of a similar experiment summarized in Technical Bulletin 42. Nitrogen shows little or no significance; the accumulation of carbohydrates is the factor most closely related to the formation of flower buds. (*Adams Fund*)

Pollination Tests Continued

Pollination tests were continued in 1933 by L. P. Latimer, with McIntosh trees under cheesecloth cages in orchards located in Atkinson and Durham. Weather conditions were exceptionally favorable for obtaining a set of fruit. Even with Gravenstein pollen, 46 per cent of the spurs set fruit, and with Baldwin a set of about 30 per cent was noted. Under ordinary conditions the pollen of these two varieties do not give satisfactory results.

When pollinated with Wealthy, Red Astrachan, Delicious and Fameuse, 50 per cent or more of the spurs set fruit. Hand pollination with McIntosh pollen gave a set of 10 to 11 per cent in Durham, which is about as high as any previously recorded.

The set obtained with Baldwin pollen is higher than any recorded during the six years of the experiment. Only once was the set with Gravenstein as high. Despite this, fruits produced by these two varieties were characteristically poor in shape. (*Purnell Fund*)

Fruit Storage Tests Continue

If McIntosh apples remain in a warm place 5, 10 or 20 days after picking and before storing, their acidity and solidity rapidly decrease and their ground color quickly turns yellow, according to immediate-and-delayed-storage tests continued for the third season by E. J. Rasmussen.

Although characteristic of the immediately-stored apples in the previous two years' work no brown core developed in any lot the past year. This may have been due to the large amount of commercial fruit in storage which for the first few days kept the room at a higher temperature and acted like a delay in storage.

When shifted from cold storage to retail-store temperature, apples remained 100 per cent marketable for two weeks if they had originally been stored within five days after picking. If storage had been delayed 10 days, 40 per cent were unfit for marketing after two weeks at retail store temperature. A 20-day delay left only 50 per cent able to withstand two weeks' display.

Fruit in common storage ripened much faster than fruit in cold storage. Common-storage McIntosh rated much higher than cold storage fruit on November 1, and in December somewhat better. After January 1, however, common-storage fruit declined rapidly.

Fruits stored at 30 and 32 degrees reach their best flavor in February and March; after April 1 they decline rapidly in quality. It appears that the fruit at the higher temperature softens appreciably faster and decreases more rapidly in acidity, but the two lots tend to become indistinguishable in these two respects toward the end of the storage season.

As in previous years, fruit stored at 30 degrees failed to develop a satisfactory flavor until the second week after removal from storage on March 8. Then it surpassed in this respect fruit previously removed from 32-degree storage.

Two lots of Cortland apples, one picked and stored on September 30 and the other three weeks later, rated higher in flavor after January 1 than McIntosh. The latter softened in storage much faster than the Cortland, especially during the first two months.

One lot of McIntosh apples affected by corky-core as a result of the severe drought of 1932, was held until the end of storage. They remained firmer than normal fruits throughout the season and retained the same color as at harvest. Corky-core neither increased nor decreased throughout the season.

No commercial advantage was demonstrated in storing Baldwins at 30 degrees as compared with 32 degrees. Common-storage fruit developed a much better flavor earlier in the season, but its breakdown was much more rapid as the season progressed.

The keeping qualities of Baldwins from trees under sod culture did not vary significantly whether the fertilizer was complete or nitrogen only. Fruit from a cultivated nitrogen plot proved about the same in keeping quality. (*Purnell Fund*)

Removal of Spray Residues

Washing apples to remove an excess of lead and substituting calcium for the lead in the late cover sprays were features of the spray-residue investigation by G. P. Percival and G. F. Potter, prompted by new federal regulations.

The combination of a wettable sulphur with calcium arsenate and additional hydrated lime produced no appreciable damage to the fruit or foliage. Two applications of this mixture in July showed no greater residue than the tolerance on McIntosh or later varieties. Plots sprayed twice in July with lead arsenate exceeded the tolerance both for lead and arsenate.

Running the fruit through a machine with brushes and with two sets of polishing cloths did not reduce the residue sufficiently. However, when run through a paddle-type washer containing hydrochloric acid two parts by volume to 100 parts of water at 70 degrees F., both lead and arsenic were removed to a small fraction of the tolerance. (*Purnell Fund*)

Complete Fertilizer Increases Blueberry Yield

In 1932 an area of low-bush blueberries, most of which had been burned over in the spring, had varying quantities of a complete fertilizer applied to nine series of four plots .01 acres each in size, with the following results: The check plot yielded 241 quarts; that with 500 pounds of fertilizer 311 quarts; and that with 1,000 pounds of fertilizer 344 quarts; and that with 1,500 pounds of fertilizer 383 quarts. This investigation was supervised by L. P. Latimer. (*Hatch Fund*)

Three Fertilizers Valueless for Strawberries

Strawberry fertilizer treatments were replicated on 42 different blocks of soil. Each block contained five plots of .03 acres each. In addition to a general application of 20 tons of stable manure per acre these plots received respectively: 300 pounds of potassium chloride per acre, applied June 14; 400 pounds of sodium nitrate per acre applied June 14; and 600 pounds of acid phosphate per acre applied June 14. The two check plots received only the manure. The acid phosphate showed no effect, sodium nitrate was definitely harmful, and potassium chloride showed a slightly harmful effect. (*Hatch Fund*)

New Fruit Varieties Bear First Time

Melba, Macoun, and Milton apple trees bore fruit for the first time in the university orchards during 1933. Their crop is described by L. P. Latimer as follows:

The Milton was very productive for a young tree. The fruit is of an attractive bright to deep crimson color on a nearly white background. The flesh is crisp, juicy, and of an excellent flavor resembling the McIntosh. It is a cross of the McIntosh and Yellow Transparent. It ripens two are three weeks before the McIntosh and is suitable only for immediate use.

The Melba as grown here is of good quality, pale pink in color, somewhat striped and blushed. It is very early, ripening the last of July.

Macoun is a cross between McIntosh and Delaware Red. The fruit matured about three weeks after McIntosh and was a very attractive dark red color. The flesh is firm, crisp, juicy, and delicious. The variety gives promise of keeping well in storage.

Larger crops of Starkings are now being harvested at the university. This variety is similar to the Delicious in all respects except that it colors earlier and better. It may be picked earlier, thus avoiding water core, one of the serious troubles of the Delicious variety.

A number of varieties of pears planted in 1918 yielded for the first time. The Tyson, Bartlett, Anjou, Angouleme, Bosc, and Sheldon all appear promising. Anjou has the best keeping qualities in storage, and Bosc is second in this respect.

The three varieties of raspberries planted in 1931 were Chief, Viking and Lloyd George. The Lloyd George is of low quality and susceptible to mosaic. Its canes are not upright. The Chief is better and hardier than the other two varieties, although not entirely immune to mosaic. Their berries have a good flavor but are small and soft and do not sell as readily as the Latham. (*Hatch Fund*)

Manure Is Enough for Cabbage

In eight different tests with cabbage, using varying amounts and combinations of acid phosphate, calcium sulphate, and muriate of potash with 20 tons of manure per acre, it was found by J. R. Hepler that none of these treatments influenced the yield significantly. Evi-

dently 20 tons of manure per acre produces good cabbage without supplementary fertilizer in years of high rainfall. (*Hatch Fund*)

Nitrogen Alone Suits Apple Orchards

As an average of four seasons G. F. Potter finds that the yield from McIntosh trees under cultivation has not been increased by the use of a complete 7-8-5 fertilizer as compared to a mixture of nitrate of soda and sulphate of ammonia carrying the same quantity of nitrogen.

In the case of a mature Baldwin orchard in sod, the trees receiving the complete fertilizer bearing part of the nitrogen in the form of tankage have definitely yielded less than those getting only nitrogen in the mixture mentioned above. (*Hatch Fund*)

Vegetable Breeding Continued

For several years six different strains of vegetables have been grown in South Carolina and in New Hampshire and the seed selected in each locality and exchanged annually. Some variations have been noted by J. R. Hepler.

In the case of corn the South Carolina selection is about 20 per cent taller than the New Hampshire strain, but the ears are slightly shorter and there is a lower number of rows of kernels per ear.

The two strains of hull-less popcorn do not seem to differ materially. The strains of Bountiful beans, Des Moines squash, and Bonny Best tomatoes also appear identical. The New Hamphire selection of Emerald Gem muskmelon seems to be greater in size. They weighed 1.9 pounds each as against 1.4 for the South Carolina selection.

As a separate phase of this project, fifth generation selections were grown from a cross of Black Beauty and Dwarf Purple eggplant. Some strains show promise of having fair size combined with sufficient earliness to make them practical under New Hampshire climatic conditions. (*Hatch Fund*)

Electric Hotbed Operated in Winter

The electric hotbed was operated throughout the winter with the thermostat set at 50 degrees F. This kept soil and air above freezing at all times. The kilowatt hour consumption per day for each greenhouse sash three by six feet is reported by J. R. Hepler as follows: November 3.4, December 3.8, January 3.8, March 3.3, April 2.9, and May 1.8. (*Miscellaneous Income*)

Tomatoes Grown in Sand

Fifty-one Comet variety tomato plants of the Field Station strain were set in sand on January 1, 1933. They were grown on a complete nutrient solution of calcium nitrate, potassium phosphate, and magnesium sulphate by J. R. Hepler. An average crop of 7.8 pounds per plant was realized. The tomatoes averaged 3.8 ounces. (*Miscellaneous Income*)

Manure and Peat Moss Give Equal Results

Two plots of tomatoes in the vegetable house were fertilized by spading two or three inches of fairly well rotted manure into the soil, and two others by spading in one bale of peat moss for 500 square feet of bed. The yield of fruit in each case was practically identical, according to J. R. Hepler. (*Miscellaneous Income*)

Sweet Corn Variety Tests

In a test of 35 varieties and strains of sweet corn by J. R. Hepler, Golden Gem proved earliest, with ears marketable in 70 days from planting. Spanish Gold required from 80 to 83 days, while most strains of the Golden Bantam required about 85 days. (*Micellaneous Income*)

Pritchard Desirable New Tomato

Eighteen varieties of tomatoes including several recently introduced were grown in the field, and records were made of the total yield, average size of the fruit, and other important characteristics. A severe epidemic of late blight occurred during August. The later varieties seemed to be more resistant than the earlier ones and thus yielded more. J. R. Hepler found that Pritchard appeared the most desirable among the new early varieties. (*Miscellaneous Income*)

Raspberry Pruning Not Beneficial First Year

In the raspberry pruning project a 100-foot row of Chief variety which was not pruned, yielded at the rate of 3,495 quarts per acre. A similar row that was thinned without heading back the canes, yielded 2,725 quarts. The fruit was of better size than in the first plot. When canes were headed back to a height of three feet without pruning, 3,300 quarts of good sized berries were realized. L. P. Latimer points out that if the canes are not thinned out annually, the new canes probably will not be as strong and possibly may not produce as many fruit buds. (*Miscellaneous Income*)

Codling Moth Serious in Some Localities

Records of the number of adult codling moths caught in fermented bait traps in four orchards in different sections of New Hampshire indicate that this pest is serious locally, says E. J. Rasmussen. In the University orchard in Durham only 25 moths were caught during the entire season, while other places got as high as 153 in a single night. A number of trees in each orchard were banded with two-inch corrugated paper bands soaked with beta-napthol oil mixture. One orchard in Durham gave an average of one-tenth moth per band. At Hollis an average of 30.3 were found, and at Wilton 113.

A number of fruit growers were assisted in maintaining railroad worm traps in important localities. These furnish evidence that there is a considerable difference in the date of emergence of these flies. Hence it would be wise for a grower who desires to spray to control

this insect, to maintain traps for his own information. The first flies were noted in Wilton on June 28; they emerged in South Lyndeboro on July 14.

For the first season since observations have been made, mature ascospores were abundant in New Hamphire orchards when the trees were in the delayed dormant stage and prior to the pre-pink stage at which New Hampshire fruit growers generally apply their first scab spray. It was not until May 20 that sufficient rain occurred at high enough temperature to develop scab infection. About June 12 some scab infection was noted in the University orchard. Orchardists who had applied the calyx spray promptly and thoroughly were well protected during this period and suffered no loss. (*State Spray Service*)

Spraying Versus Picking Drops for Railroad-Worm Control

Spraying was contrasted with picking drops as a control for railroad worm in two apple orchards last season by W. C. O'Kane and J. G. Conklin. The work will be continued in 1934, when some conclusions may be drawn.

Clean-up measures were also on trial in a commercial orchard in Wilton and will be tried another year before judging their effectiveness.

The Wilton orchard was selected as a typical commercial orchard which has suffered severe losses the last few years because of railroad worm. A number of old, neglected apple trees were found nearby and are being removed this winter. The orchard is isolated from other fruit blocks.

As the 1933 season progressed, infestation in many of the Baldwins and Wealthies was found to be running between 85 and 95 per cent. All dropped fruit was gathered from the entire orchard and dumped 1,500 yards away. It will be treated with crankcase oil next spring to destroy the pupae of the fruit pest. Next season should show considerable improvement in the quality of the fruit.

University orchards, one of 200 and another of 50 trees, were used in the experimental work on spraying versus picking drops.

The 200-tree sprayed orchard showed in general a rather light infestation of railroad worm this season, but certain trees were more heavily infested. Wealthies were more heavily infested than McIntosh. One tree of unknown variety showed an infestation of practically 100 per cent, the majority of its apples harboring two or more worms per fruit.

Infestation in the 50-tree check orchard was not as heavy as expected, even though it had received no sprays of any kind.

To determine the peak in numbers of railroad-worm flies emerging from the soil to lay eggs in the forming apples, cages were placed under trees in the orchards. The first peak of emergence occurred July 8, but this was followed by a much greater peak on July 20 and still greater ones July 24 and 26.

Railroad-worm sprays were applied in the larger orchards on July 7 and 8, and again July 21. Rain before the latter dried, necessitated

respraying July 25. Part of this orchard received arsenate of lead sprays. The remaining trees got calcium arsenate. (*Hatch Fund*)

Insect Records Enlarged

The season just closed has witnessed some unusual developments in the insect fauna of New Hampshire. Species of economic importance have appeared in numbers at points farther north than hitherto known. Records have been made of their distribution, economic status, and food plants, and entered in the regularly maintained card index of injurious insects. (*Hatch Fund*)

Contact Insecticides

Two pieces of research on contact insecticides have been completed and published by W. C. O'Kane, J. G. Conklin, L. C. Glover and W. A. Westgate.

The first of these concerned the reactions of certain insects to small and constant applications of several concentrated chemicals, some of which are especially toxic when applied to sensitive areas on the integument of an insect. A detailed study of the reactions induced by these applications was carried out and the sensitivity of various areas was determined. The chemicals used included a relatively high concentration of an extract of pyrethrum flowers, 95 per cent nicotine, cocoanut-oil fatty acid, kerosene, and a so-called white oil.

The second line of research was concerned with a comparative study of the toxicity of 45 organic compounds, utilizing a technique developed from the research already described, by which small droplets of constant size of the pure chemical were applied to definite areas on the surface of the larva of the common meal worm *Tenebrio molitor* Linnaeus. This study was supplemented by a parallel series of experiments in which the same substances were diluted and applied as a spray to plant lice.

The two reports giving the results of these two investigations were combined in Technical Bulletin 54, "Studies of Contact Insecticides —VI", entitled "1. Reactions of Certain Insects to Controlled Applications of Various Concentrated Chemicals. 2. A New Technique for Initial Appraisal of Proposed Contact Insecticides."

Following this the entomologists began a study of the changes brought about in blood cells and in nerve cells of an insect through application of concentrated chemical substances to sensitive areas on the integument. This necessitated the development of a suitable technique in fixing and staining of blood cells and nerve cells. Much time has been spent on this technique, and a suitable procedure has now been worked out. The department is now undertaking detailed histological studies from which it is hoped to derive information as to the manner in which toxic substances bring about the death of an insect.

An additional study now undertaken is concerned with the relative contact performance of a typical so-called "wetting agent" on leaf surfaces and on the surface of an insect. Much confusion exists as

to the real objective sought when a so-called wetting agent is added to a contact insecticide. The importance of accomplishing rapid spread over the body of an insect is often lost sight of and attention is centered on spread over leaf areas. While the latter has a definite place in the optimum performance of a given material, it remains true that spread on the surface of an insect is of particular significance.

Data already accumulated by the department indicate that a wetting agent may not give the same desirable performance on an insect that it gives on a leaf, and that important factors enter into this, including such items as the nature of the leaf surface on which a given insect happens to be feeding.

Since the department has excellent facilities for an accurate study of this question, utilizing photomicrographs of angles of contact, an investigation has been undertaken. It is expected that this will be concluded at an early date, and that results will be ready for publication as No. VII in "Studies of Contact Insecticides."

In the course of the year the department has helped to develop some new contact insecticides which utilize the principle of providing a chemical medium which affords optimum contact qualities and which serves as a carrier for relatively small amounts of an added toxic substance, such as pyrethrins, the two together operating to reenforce each other, and thereby to provide a spray that is relatively toxic to an insect and, at the same time, relatively safe to plants. (*Purnell Fund*)

Burgundy Not Always a Substitute for Bordeaux

Burgundy mixture is a copper fungicide ranking next to Bordeaux in importance, but not so generally applicable due to its particular properties, according to research concluded by O. Butler. When a Bordeaux mixture containing an excess of lime is desirable, for instance, Burgundy cannot be substituted because the translucency of the dried Burgundy spray is not materially affected while that of the Bordeaux is. But when a highly translucent material is required—as in spraying plants that are to be inspected for mosaic—the Burgundy may be used in place of the Bordeaux.

After studying several formulae recommended for Burgundy, the conclusion is that a mixture combining equal weights of copper sulphate and crystallized sodium carbonate will prove most satisfactory.

The fact that sodium carbonate loses water on exposure to air is not considered important since stock solutions will be used in practice. The strength of the latter can be checked by weighing or by using an hydrometer.

Burgundy mixture deteriorates more rapidly on standing than does Bordeaux, but can be stabilized even more effectively than the latter. (*Adams Fund*)

Lime-Sulphur Apple-Scab Spray Injury

It may be inferred from certain orchard practices that the rate of drying of a lime-sulphur spray used for control of apple scab, has an effect on the injury produced. Some experiments were made with

beans, tomatoes, and potatoes to study the effect of strength of mixture and rate of drying. Results obtained to date indicate that the rate of drying has little or no effect on the degree of injury produced. (*Adams Fund*)

Hardier Potatoes Grown at Low Temperatures

A growing temperature averaging around 58 degrees Fahrenheit is more conducive to hardiness in potatoes than a mean temperature 10 degrees higher, according to studies continued by Stuart Dunn on the effect of growing temperatures, mineral nutrition and vegetative selection on plant hardiness. His work indicates that northern-grown potatoes are likely to have greater resistance to early frosts.

Cabbage and potatoes were both grown at mean temperatures of approximately 68 degrees and 58 degrees. After reaching sufficient size plants of both vegetables were frozen, the cabbages at 23 degrees and the potatoes at 29 to 30 degrees. Both were kept at these respective temperatures for 24 hours.

In the case of cabbage the temperature at which the plants were grown did not appreciably effect their resistance to injury from freezing.

All the potato plants grown at 68 degrees, were injured when subjected to freezing, 12 per cent of them severely, 48 per cent markedly and 40 per cent slightly.

The plants raised under 58 degrees temperature showed only slight injury at most from freezing; 88 per cent were hardy enough to withstand this test.

The potatoes used in this experiment were obtained from stock originally from the same source, which had been grown to maturity at 58 and 68 degrees for three generations.

In studying the effect of mineral nutrition on resistance to freezing, sand cultures of cabbage were treated with high and low levels of nitrogen, potassium and phosphorus. Results were generally inconclusive, although apparently pointing to greater resistance in the case of high-level cultures.

In the work on vegetative selection the greenhouse plant, Bryophyllu, was mainly used, although potato and Jerusalem artichoke are also being tried. This system consists of raising plants from leaf cuttings rather than seed so as to hold to a pure strain.

In starting this research cuttings were grown from ordinary greenhouse plants of Bryophyllum and frozen for 24 hours at 1.1 degrees below zero, Centigrade. From the few which survived cuttings were eventually obtained. These produced 63 plants which were frozen with the following results: 35 uninjured, 11 slightly injured and 17 killed. (*Adams Fund*)

Leafroll, Mosaic Studies Continued

Studies of mosaic and leafroll of potatoes are being continued. No new data have been obtained other than that reported a year ago. (*Purnell Fund*)

Results on Apple-Scab Sprays Repeated

Results with apple-scab sprays continue to show that 200, 300, and 400-pound pressures give substantially the same degree of control. This, the investigator, O. Butler, points out, need cause no surprise since coverage is the important thing and not the pressure with which the coverage is obtained. Another finding is that night spraying gave as satisfactory control as day spraying. (*Hatch Fund*)

Crop Size and Harvest Date Influence Bitter-Pit

Evidence continues to pile up, showing that the fertilizer treatment of the orchard has little if any effect on the development of bitter-pit in apples, but that the size of the crop and the date of harvest do influence the amount of infection.

O. Butler found that fruit picked after October 15 exhibited less than 30 per cent bitter-pit infection after several months storage, while fruit picked previous to that date developed nearly 50 per cent infection. The fruit selected for the storage test was free from evidence of the malady, but was harvested from trees in which the disease had developed. (*Purnell Fund*)

Tests of Weed Killing Chemicals

Comparative trials with sodium chlorate and ammonium thiocyanate as weed killers showed both to be equally strong, but the sodium chlorate poisons the soil for all plants for a long period of time, while the ammonium thiocyanate soon proves stimulating to new growth.

Both herbicides were applied as sprays in field control of yellow hawkweed, the chlorate in amounts equivalent to 100, 200 and 400 pounds per acre and the thiocyanate at the rate of 50, 100, 200, 400 and 800 pounds per acre. When more than one spray was used the interval between applications was approximately 25 days. More than two sprays were seldom needed.

On a weight basis the herbicides proved equally toxic, although the chlorate seemed somewhat less active in the latter half of the season while the thiocyanate remained equally toxic throughout.

In checking on the persistency of toxicity, four crops of wheat were grown in pots over a period of 210 days, the chlorate having previously been applied in amounts equivalent to 100, 200, 400 and 800 pounds per acre. When the last crop was harvested only the plants in pots which had received the smallest application of the herbicide were found to have grown normally.

Three successive crops were grown in soil treated with the thiocyanate, and the second crop showed stimulation regardless of the amount of the herbicide that had been used.

Sixty-three days after the herbicides were applied, ammonium thiocyanate used at the rate of 800 pounds per acre was stimulating growth, while sodium chlorate at only 100 pounds per acre was still toxic. (*State Fund*)

Colon Test Not Substitute for Inspection

As a check on sanitary conditions, the laboratory test for the gas-producing colon organism in milk is not a reliable substitute for dairy farm inspection by boards of health, according to a study conducted during the past year by H. C. Moore.

Some authorities have felt that the presence of this undesirable type of bacteria is a definite indication of unsanitary conditions, particularly as to contamination from fecal material, from dirty utensils and from the exterior of the cow. Others have not agreed. Our investigation shows no relation between the colon organism in milk and the condition under which the milk was produced.

Bacterial counts were made of 683 samples of milk taken from 108 farms. These farms were also scored with the use of the dairy score card of the state board of health.

Milk from 56 of the farms showed colon counts on one or more samples. Three hundred and forty-five samples were taken from these farms, but only 131 or 37.97 per cent carried the organism.

While 17 of these farms had barns and equipment scoring less than 60, as compared with nine in the non-colon group of 52, no direct relationship was found between the score and the presence of colon or between the score and the average bacteria count.

Of the 55 farms having poor or dirty equipment, only 22 or 40 per cent were in the colon group. (*Purnell Fund*)

Rabbits Benefit Forest Stand

Investigation of the damage done by cottontail rabbits to the stands of mixed young hardwoods and conifers indicates that the rabbits tend to improve the composition of the stand.

They show preference for certain species, others they will attack, and others they do not seem to bother. The sprouts of the preferred trees have little or no chance for survival, and these species will usually be entirely removed from the stand.

The composition of the mixture undergoes a decided change. The percentages of white pine, hemlock, and gray birch show decided increases. Blue beech, red maple, and hop hornbeam are decreased. These may be considered as beneficial changes. Others not so good, include decreases in the per cent of red oak, sugar maple, basswood and beech, and increases in the per cent gray birch, choke cherry, and speckled alder. (*Hatch Fund*)

New Poultry Disease Is Not Spreading

Epidemic tremor, or trembling chick disease as it is popularly known, recently made its appearance in a few flocks in the Northeast. Fortunately it does not seem to spread and in some cases may have been confused with the so-called "crazy-chick" disease. It is believed that epidemic tremor is caused by a virus, an organism so infinitely tiny as to escape the range of the strongest microscope. It is characterized by distinct trembling or tremors, and this may be accompanied by

ataxia or muscular incoordination, the result of which is that the chick walks unsteadily.

Research on this disease has been done cooperatively by the poultry and agricultural chemistry departments of the New Hampshire Experiment Station and the department of comparative pathology, Harvard Medical School. Dr. E. Elizabeth Jones represented Harvard. New Hampshire workers were C. A. Bottorff, T. B. Charles, C. L. Martin, F. D. Reed, A. E. Tepper, and S. R. Shimer.

The disease has been transferred experimentally to normal chickens by intracerebral inoculations of suspensions of brain and spinal cord of affected birds. During the course of 20 passages the virulence has been increased.

Attempts to demonstrate the presence of the infective agent in brains of chicken embryos have been inconclusive.

This disease last year in a group of experimental chicks caused a mortality of from 12 to 57 per cent, varying among the groups. Efforts to cause a spread of the disease by contact of the infected and non-affected stock proved futile. It appears the disease is not highly infectious.

Injections of calcium gluconate, azamine, flavine, and glucose solution were administered. After eight days' treatment the chicks were apparently in the same condition.

A series of six hatches involving 32 groups of about 50 chicks each from parents of the chicks which first exhibited the disease showed a high mortality. However, lesions attributable to the disturbance known as epidemic tremor could not be found.

Pedigree hatching was done in another phase of the investigation. Five successive hatches of eggs produced by the parents whose offspring had exhibited the disease, gave great variations in results. Eggs of individual birds varied from zero to 100 per cent hatchability. The livability of chicks varied somewhat.

Selecting 75 affected pullets and six affected cockerels from the original diseased stock and combining these with a normal group of males and females, permitted a series of crosses for further study. Five hatches were made during the course of this experiment, and while mortality was high in some groups, in no case were any symptoms noticed nor autopsy diagnosis made of the presence of epidemic tremor. No significant relationship was discovered between weight of chicks and mortality, or between per cent hatchability within groups, and mortality.

The data secured do not give foundation for any definite conclusions. The crosses involving tremor-affected pullets gave poorest results in livability of chicks, however, but this is undoubtedly due to the poorer physical condition of the parents which resulted in lower vitality in the offspring.

In an effort to discover any derangement in the composition of the blood of birds affected by this disease, 15 birds were taken from a hatch where affected chicks were found. They themselves showed no clinical symptoms of the disease. From the same lot 15 chicks showing symptoms of the disease were also used. These chicks were 17 weeks

old at the start and 23 weeks old at the finish. Fifteen normal chicks starting at 21 weeks and ending at 23 weeks were used for a normal count. Determinations were made on the number of red blood cells, white blood cells, hemoglobin, lymphocytes, polymorphonuclear leucocytes, mononuclear leucocytes, mast cells, and eosinophyles.

The affected groups were higher in both red and white blood cells, although not significantly so. The hemoglobin was higher in the affected groups. Polymorphonuclear leucocytes were low in all groups but highest in the affected group with symptoms. The mononuclear leucocytes were high in both affected groups showing some cause for their production to help fight the infection. Mast cells which originate from the bone marrow were higher in the affected groups. The eosinophyles are low in the affected groups which is to be expected when there is an increased number of white blood cells above normal, as was the case of the diseased groups. (*Purnell Fund*)

New Findings on Vitamin A for Chicks

Research last year indicated that the demand for Vitamin A increases as the growing chick approaches maturity. In further work by A. E. Tepper, a group of 50 New Hampshire Red chicks were fed increasing levels of Vitamin A through the medium of standardized cod-liver oil. Little benefit was gained, however, over the common method of supplying one per cent cod-liver oil in the ration throughout the experimental period. The extra effort and cost expended for labor is not warranted.

In another comparison of feeding levels of one, two and three per cent of cod-liver oil standardized at 2,000 Vitamin A units per gram, the one per cent level was found to be most efficient and economical.

Chicks deficient in Vitamin A at four weeks of age were given a quantity of cod-liver oil equal to 16,000 units per chick. No mortality occurred in this group after this feeding, opthalmia disappeared, and weight gains were resumed at a normal rate. (*Purnell Fund*)

Poultrymen Strive to Retain Breeding Reputation

Despite their well-founded reputation for well-bred poultry, New Hampshire poultrymen set another milestone along the road of better breeding, forming a record of performance association in 1932. This calls for official trapnesting of breeding birds to prove their ability to transmit the quality of high production to future generations of layers. Six poultrymen have taken advantage of this inspection service supervised by F. D. Reed. Of 1,555 birds entered by them in the 1932-33 year, 364 qualified for R. O. P. certificates, 182 meeting the minimum requirement of at least 200 eggs a year, 77 producing from 225 to 239 eggs, and 100 from 240 to 300 or more eggs. Five birds merited two-year certificates.

Certification work was also continued in 1932-33 by F. D. Reed. This is a step following the accreditation of flocks free from pullorum disease and consists of grading a group of birds into three classes—breeders, layers, and culls. The latter are suitable only for market-

ing for meat purposes. A total of 18,295 birds were handled during the year at a cost to the poultrymen of three cents per bird. Eighteen flocks were certified up to December 1, 1933. (*Miscellaneous Income*)

Adult Mortality Is Studied

Despite the advances in breeding, adult mortality is one of the poultrymen's greatest problems. This has been on the increase during the eight years of the state home egg-laying contest, rising from 12 per cent in 1925-26 to 17 per cent in 1931-32. The 1932-33 figure dropped back to about 14 per cent, due principally to a decrease in cannabilism, prolapsus, and pick-outs. Management practices to discourage these habits were more widely adopted during the year.

The 17 per cent mortality of a year ago alarmed poultrymen and they requested help in controlling this loss. Eleven of them cooperated by bringing their dead or sick birds to the pathology laboratory every day or two. Examination of 368 adult birds by C. L. Martin and C. A. Bottorff continued from February 1 to July 1 and revealed that 87 per cent were affected with ruptured egg-yolk. This is believed to have been caused by some type of mechanical injury and recommendations issued called for careful handling of pullets at housing time, construction of equipment such as nests and roosts at proper heights for convenience and comfort of birds, and prevention of fright. No evidence yet gained proved that losses from ruptured egg-yolk are due to cholera or pullorum disease. (*State Fund*)

Fowl Pox Is Increasing

Fowl pox is gradually pushing north in New Hampshire, with first cases reported about ten years ago. No vaccination campaign has been pushed because every poultryman who vaccinated would thus force his neighbors to vaccinate in self-defense. Vaccination has been recommended by C. L. Martin and C. A. Bottorff only for poultrymen whose flocks have had the disease in recent years, who have possible sources of infection nearby, or who observe first symptoms in their flocks. Approximately three times as many birds were vaccinated in 1932-33 as compared with 1928-29, or a total of 193,300 on 133 farms last year. (*State Fund*)

Pullorum Disease Controlled by Short Interval Testing

Short interval testing for pullorum disease by standard tube agglutination test included work on flocks varying in size from 600 to 4,500 birds and showed that three to eight monthly tests are necessary to eradicate infection.

These trials by C. A. Bottorff indicate that in the average flock, the most economical procedure is to select a small breeding unit of the best birds in the flock for short interval testing. This unit should be large enough to replace the whole flock the next season by making a large number of small hatches. These eggs should be used for hatching only if the unit has passed one or more free tests without reactors. (*Purnell Fund*)

Two Tests for Pullorum Disease Compared

That the rapid whole-blood test for pullorum disease is not as accurate as the standard tube method is indicated by comparative work on 242 birds, about 30 of which reacted to the tests. This investigation was conducted by C. A. Bottorff. (*Miscellaneous Income*)

Inoculation Not Practical for Coccidiosis

Three lots of chickens were inoculated at different ages with E. tenella in the studies of control of coccidiosis of poultry. Those which survived the initial inoculations showed immunity to E. tenella on later inoculations. Getting the correct dosage of the inoculant was difficult. Mortality was so high that even though immunity was produced, this method does not seem advisable under practical conditions, in the opinion of the investigators, C. L. Martin, C. A. Bottorff, and T. B. Charles.

In the study of control agents five groups of chickens were inoculated and as soon as definite symptoms developed four groups were treated and the fifth used as a control group. Epsom salts, baking soda, 40 per cent milk mash, and enteritis powder were used.

The best results were obtained from the use of Epsom salts given in drinking water at the rate of one pound to 500 pounds live weight of chicks. This treatment gave the quickest action and less mortality. Baking soda and 40 per cent milk mash were on a par, and much better than the enteritis powder. (*Purnell Fund*)

Control Studies on Contagious Abortion Gives Results

Six herds, one dispersed, were used by C. L. Martin in practical field testing for control of contagious abortion in cattle by the agglutination test.

The university dairy herd consisting of 90 head continued to remain negative to the Bang's disease agglutination test, as it has since January 1929, when one reactor was found and eliminated.

Of the other five herds, four have been improved by isolation and elimination of reactors.

A total of 3,450 samples of blood were tested for Bang's disease by C. L. Martin, 2,615 of them coming mainly from practicing veterinarians in New Hampshire and the remainder from herds in Vermont, Maine and Massachusetts. In general herds tested for the first time show the animals about equally divided among positive, suspicious, and negative classifications. (*Purnell Fund*)

One-Fifth of Poultry Tested for Pullorum

During the testing season from July 1, 1932, to June 30, 1933, 239,397 samples from 212,363 birds were tested for pullorum disease by C. A. Bottorff. This is more than one-fifth of the total number of adult birds in New Hampshire, and of these birds tested 99.54 per cent were found to be free from the disease.

There are 133 flocks representing 162,882 birds that have been negative three or more years.

Nine different breeds of birds were tested and infection was found in only four. New Hampshire Reds, Barred Plymouth Rocks, Single Comb White Leghorns, and White Plymouth Rocks showed one-half of one per cent infection; Rhode Island Reds, Cross-Breds, White Wyandottes, Minorcas, and Rhode Island Whites showed no reactors.

The New Hampshire Department of Agriculture published a list of poultrymen whose flocks passed the accredited and 100 per cent free requirements. Fourteen new flocks were added to the accredited list and five were removed for failure to test, and one accredited flock was removed when reactors were found in the flock. There were 98 accredited flocks having 99,338 birds, and sixty-three 100 per cent flocks totalling 61,006 birds. (*Miscellaneous Income*)

Over 3,000 Poultry Autopsies Made

Poultry autopsies made at the poultry pathology laboratory by C. L. Martin and C. A. Bottorff for the past fiscal year amounted to 3,068, of which 1,580 were adults, 1,442 chickens, 28 turkeys, 9 pigeons, 8 ducks, and 1 gosling. This is nearly twice as many specimens as were examined the previous year.

In the adult class the principal diseases were: ruptured egg-yolk 31.77 per cent, coccidiosis 19.05 per cent, nephritis 18.10 per cent, peritonitis 9.55 per cent, cannibalism 7.46 per cent, pneumonia 5.75 per cent, and indigestion 5.37 per cent.

In the young chickens the principal diseases were pneumonia 45.90 per cent, indigestion 14.90 per cent, pullorum disease 14.14 per cent, and coccidiosis 12.82 per cent. (*State Service Fund*)

Electric Brooding of Chicks

One season's trials in which electric brooders have been used in individual, unheated brooder houses have proved that this method is practical in this climate without the use of auxiliary heat. Experiments started in the fall of 1933 and carried on through the winter have had the benefit of unusually severe temperature conditions. The work has been carried on co-operatively by W. T. Ackerman, G. M. Foulkrod, A. E. Tepper, and the staff of the Poultry Pathology Laboratory.

The most significant result is the carrying of over 1,000 chickens through temperatures as low as 30° below zero with a mortality of only 6.7 per cent and a cost of operation of 1.2 kilowatt hours per chick per brooding period.

Observations were made of temperatures, humidity, ventilation, insulation, and house construction, from which, through continued tests, standard recommendations can be arrived at for the most effective use of this equipment. (*Purnell Fund*)

Pneumatic Tires for Truck

Experiments were started in the fall of 1933 by W. T. Ackerman and G. M. Foulkrod to investigate the feasibility of pneumatic tires

on tractors. Two standard tractors in use on the college farm were equipped with two different sizes of these tires, and a few preliminary trials were run before freezing weather set in. First tests indicate that these tires will provide adequate traction under any and all conditions if supplemented, in wet and slippery weather, with a recently developed special type of tractor-tire chain-lug.

A satisfactory job of plowing was done through a bog hole where water stood to a depth at which the plows were completely submerged in turning the furrow.

The additional cost of tire and steel equipment, cost of upkeep, depreciation and similar practical operating problems are to be studied to determine whether the investment is justified in economies affected and improved operating features. (*Purnell Fund*)

Steel Tractor Wheel Equipment

Tests of a new design of steel tractor wheels were conducted in the summer of 1933. The equipment is designed to permit the clamping on of two large flat rims over the lug equipment so that travel on hard surfaced roads may be accomplished without damage to the road surface. On flat macadam roads, with reasonable loads, no particular difficulty was experienced, and the equipment was satisfactory. On grades and on gravel surfaced roads wheel slippage was excessive, and the difficulty of steering increased. Whereas the rims are designed to be demountable with reasonable ease, the frequent changing of these road-rims proved bothersome, especially where the type of road varies frequently. With road rims removed, the steel lug equipment performed satisfactorily under field conditions. Continued tests of the equipment are to be made by W. T. Ackerman and G. M. Foulkrod. (*State Fund*)

Electric Water Heating and Sterilization

The heating of water for washing, rinsing and sterilizing dairy utensils is a problem confronting most dairy farmers. In tests made by W. T. Ackerman and H. N. Colby of 5, 10 and 30 gallon electrically heated tanks of various sizes and kinds, 5 and 10 gallon electrically heated open-top tanks were found particularly suited to provide the necessary hot water, and to sterilize the smaller essential parts of milking equipment at a moderate investment cost and a reasonable cost of operation. In the case of one farm test, the owner found that the savings in the cost of rubber equipment for the period of a year, as compared to the older method of boiling these rubber parts in a washboiler on the stove, was sufficient to pay considerable part of the current bill.

Electrically heated cabinet sterilizers employing the combination of moist air turning to dry air, operating at a temperature of approximately 170°, have also been found to provide a higher degree of sterilization and also a sanitary storage space for the equipment after this process. Their higher initial cost retards their adoption by many farmers, particularly at this time. (*State Fund*)

Inspection Service

Feeding Stuffs. In the enforcement of the law regulating the sale of concentrated commercial feeding stuffs, 386 brands were analyzed for the state department of agriculture. These analyses required about 2,900 individual determinations.

Fertilizers. In the enforcement of the law regulating the sale of commercial fertilizers, 109 brands were analyzed for the state department of agriculture. These analyses required about 750 individual determinations.

Samples of soils, peats, leaf molds, fertilizers, feeding stuff and other materials have been sent to the department by residents of the state. Of these 179 have been analyzed, involving about 212 individual determinations.

Seed Inspection. The regular seed inspection work for the State Department of Agriculture was conducted as usual. During the year ending July 1, 1933, 408 samples of seed were handled in the laboratory. Of this number 384 were collected by the State Inspector and are reported in Bulletin No. 276. The remaining 24 samples were sent in by private individuals.

Advanced Registry. Advanced Register and Register of Merit tests were made on 181 cows during the year. There were 245 cows entered for breed herd tests.

Seed Certification. Of 45 acres entered for certification in 1932, 43 acres passed final inspection. (*Miscellaneous Income*)

FINANCIAL STATEMENT

Expenditures of the New Hampshire Agricultural Experiment Station for the Year Ending June 30, 1933

	Hatch Fund	*Adams Fund*	*Purnell Fund*	*Supplementary**	*Total*
Personal services	$10,455.56	$13,325.78	$47,900.48	$23,903.50	$95,585.32
Supplies and materials	526.65	712.43	2,909.24	4,065.49	8,213.81
Communication service	906.59	1.43	60.18	293.13	1,261.33
Travel expenses	455.01	38.61	3,607.26	3,463.00	7,563.88
Transportation of things	319.70	33.03	184.15	164.97	701.85
Publications	717.40	.....	943.27	272.94	1,933.61
Heat, light, water, and power	700.73	.....	65.49	.....	766.22
Contingent expenses	38.38	2.14	60.94	1,126.47	1,227.93
Equipment	879.98	493.85	2,915.70	1,615.32	5,904.85
Buildings and land	.....	392.73	1,353.29	70.00	1,816.02
Balance	.....	.....	.....	9,720.27	9,720.27
Totals	$15,000.00	$15,000.00	$60,000.00	$44,695.09	$134,695.09

*This fund includes expenditures from the following sources:

State appropriations	$4,181.63
Sales and miscellaneous income	40,513.46
	$44,695.09

New Hampshire Agricultural Experiment Station Staff

ADMINISTRATION

Edward M. Lewis, A.M., L.L.D., Litt.D., *President*
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Francis E. Perkins, B.S., *Editorial Assistant*
Raymond C. Magrath, *Treasurer and Business Secretary*
Marvin A. Miller, B.A., *Librarian*

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Stanley R. Shimer, M.S., *Assistant Chemist*
Gordon P. Percival, M.S., *Assistant Chemist*
Henry A. Davis, B.S., *Graduate Assistant in Biological and Agr'l Chemistry*

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Max F. Abell, Ph.D., *Assistant Agricultural Economist*
Earl H. Rinear, M.S., *Specialist in Marketing*
Charles W. Harris, Jr., B.S., *Research Field Assistant in Agr'l Economics*
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Leroy J. Higgins, B.S., *Assistant Agronomist*
Betty G. Sanborn, *Seed Analyst and Secretary*

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Nicholas F. Colovos, M.S., *Assistant in Animal Husbandry*
Lloyd Washburn, B.S., *Graduate Research Assistant in Animal Husbandry*
Albert D. Littlehale, *Shepherd*
Helen H. Latimer, *Gas Analyst*

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Stuart Dunn, Ph.D., *Assistant Botanist*
L. J. Bowen, B.S., *Graduate Assistant in Botany*

DAIRY

John M. Fuller, B.S., *Dairy Husbandman*
Herbert C. Moore, M.S., *Assistant Dairy Husbandman*

RURAL ELECTRICITY

Walter T. Ackerman, B.S., B.S.A.E., *Agricultural Engineer*
George M. Foulkrod, M.S., *Assistant in Agricultural Engineering*
Halstead N. Colby, B.S., *Assistant in Agricultural Engineering*

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James G. Conklin, M.S., *Assistant Entomologist*
Leon C. Glover, M.S., *Research Assistant in Entomology*
Warren A. Westgate, M.S., *Research Chemical Assistant in Entomology*

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CLARK L. STEVENS, Ph.D., M.F., *Assistant Forester*

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E. J. RASMUSSEN, M.S., *Research Assistant in Horticulture*
JAMES MACFARLANE, *Florist*
LOUIS R. BRYANT, M.S., *Graduate Assistant in Horticulture*

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ALBERT E. TEPPER, M.S., *Assistant Poultry Husbandman*
CARL L. MARTIN, D.V.M., *Veterinarian*
CHARLES A. BOTTORFF, Jr., D.V.M., *Poultry Pathologist*
FRANK D. REED, B.S., *Poultry Certification Inspector*
ELMER W. LANG, *White Diarrhea Tester*
ROSLYN C. DURGIN, B.S., *Assistant Poultry Tester*
ROGER C. HAM, *Laboratory Technician in Poultry Husbandry*

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KATHRINA LEGG, *Stenographer*
NETTIE DURGIN, *Clerk*
MARGARET J. BLOOD, *Stenographer*
PHYLLIS SEYMOUR, *Stenographer*
MARION HUTCHINS, *Stenographer*
MARGARET ROSE, *Stenographer*
AMBER HALL, *Stenographer*
SARA M. SANBORN, *Stenographer*
CELIA SEVIGNY, *Stenographer*

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